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**Unit 6, Part 3 Notes – Anaerobic Cellular Respiration**

Ms. OK, AP Biology

1) Anaerobic respiration (aka fermentation) enables some cells to produce ATP in the absence of oxygen.

a. Without oxygen to accept electrons in the electron transport chain, most of cellular respiration stops, but fermentation provides a mechanism by which some cells can continue to oxidize (break down) organic molecules like glucose and generate ATP.

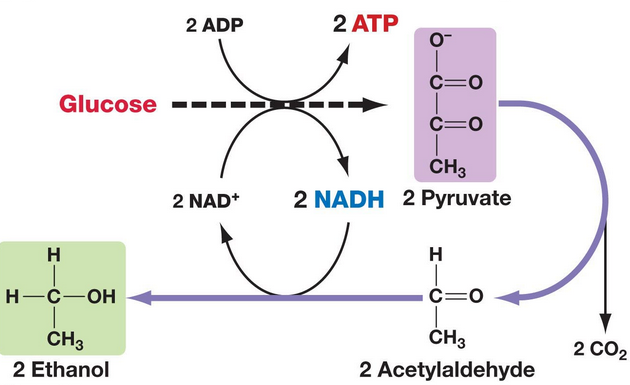
b. In glycolysis, glucose is oxidized to two pyruvate molecules with NAD+ being reduced to NADH. Fermentation can generate ATP from glucose by substrate-level phosphorylation during glycolysis as long as there is a supply of NAD+ to accept electrons from glucose. If the NAD+ pool is exhausted, glycolysis shuts down. (Remember: Substrate-level phosphorylation is the type of ATP synthesis that does not use the ATP synthase protein and a proton gradient to create ATP, unlike oxidative phosphorylation.)

c. Under aerobic conditions (i.e. oxygen is present), NADH transfers its electrons to the electron transfer chain,

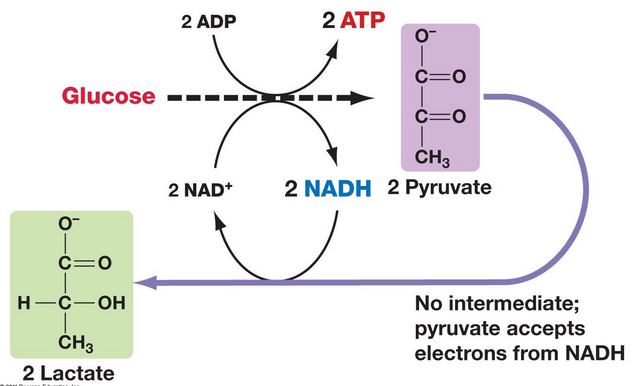
recycling NAD+. Under anaerobic conditions (i.e. oxygen is NOT present, pyruvate then accepts electrons from NADH, oxidizing it back to NAD+. The NAD+ is then available to oxidize more glucose.

d. Because the pyruvate does not enter the citric acid cycle (aka Krebs cycle), there is still a lot of energy which

is not removed from the fuel.

2) There are two types of fermentation—alcoholic fermentation and lactic acid fermentation.

a. During alcoholic fermentation (which happens in yeast and certain species of bacteria), the end products are ethanol (aka ethyl alcohol) and carbon dioxide. Pyruvate first breaks down into acetaldehyde and carbon dioxide. Then acetaldehyde accepts electrons from NADH and accepts hydrogen atoms to become ethanol. Because this process produces alcohol, it is used in the process of making beer and wine. Alcoholic fermentation is also used to help bread rise because carbon dioxide is produced, which creates bubbles in the dough.

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b. Human muscle cells switch from aerobic respiration to lactic acid fermentation to generate ATP when O2 is scarce (ex: during extreme exercise). When O2 is absent, the electron transport chain stops; therefore pyruvate accepts electrons from NADH and accepts hydrogen atoms, forming lactic acid. This waste product causes muscle fatigue and cramping, but it is eventually converted back to pyruvate in the liver. Lactic acid fermentation is also used by certain species of bacteria. Lactic acid fermentation in bacteria can be used to make yogurt.

3) How efficient is anaerobic respiration?

a. Under aerobic respiration, a molecule of glucose yields 36-38 ATP, but the same molecule of glucose yields only 2 ATP under anaerobic respiration.